Control circuit for relay-operated gas valves

The invention relates to a control circuit for relay-operated gas valves.

Gas valves are known which are opened and closed via a relay. It is also known for such relays for opening and closing gas valves to be activated via a control device developed as a microprocessor. It is important here that the overall arrangement is failsafe, i.e. that a gas valve is only opened via a relay when the control device is in a defined state. If an undefined state of the control device is present, it must be ensured that the relay cannot open the gas valve. For this, control circuits for relay-operated gas valves have a failsafe circuit in addition to the relay, this failsafe circuit being connected between the control device developed as a microprocessor, and the relay. The failure safety of the overall arrangement is ensured by the use of such failsafe circuits.

Starting from this, the present invention is based on the problem of creating a new type of control circuit for relay-operated gas valves.

This problem is solved with a control circuit for relay-operated gas valves with the features of Claim 1. According to the invention, the control circuit includes a relay for opening and/or closing a gas valve and a failsafe circuit, a control device being connectable to one input of the failsafe circuit, and the failsafe circuit only supplying the relay with a voltage necessary for opening the gas valve when an input signal having at least two different frequency signals succeeding each other in time is supplied at an input of the failsafe circuit by the control device.

It is the intention of the present invention to suggest a control circuit for relay-operated gas valves which

include a failsafe circuit, the failsafe circuit only supplying the relay with a voltage necessary for opening the gas valve when the control device supplies an input signal for the failsafe circuit, said signal having two different frequency signals defined as successive in time. The relay can accordingly only open a gas valve if the signal supplied by the control device contains the two frequency signals in the time-defined order. If only one of the two frequency signals is present, the relay cannot open the gas valve. It is thereby always ensured that the relay can only actuate the gas valve if the control device developed as a microprocessor is working properly. If the control device supplies a signal with other frequencies or a different time sequence of frequencies at the input of the failsafe circuit, the gas valve closes immediately.

According to a preferred development of the invention, the control circuit has a charging circuit and a drive circuit for the relay. The charging circuit has at least one capacitor, the charging circuit charging the capacitor or each capacitor of the charging circuit upon the application or presence of a first frequency signal in the input signal. Upon the application or presence of a second frequency signal, on the other hand, the capacitor or each capacitor of the charging circuit discharges itself. Upon the application or presence of the second frequency signal in the input signal, the drive circuit for the relay supplies the relay with a voltage necessary for opening the gas valve.

The drive circuit preferably has at least two transistors, a base of a first transistor being connected via a resistor to the capacitor of the charging circuit, and the first transistor of the drive circuit only conducting when the capacitor of the

charging circuit discharges itself upon the application of the second frequency signal in the input signal.

Preferred developments of the invention will emerge from the subclaims and the subsequent description. One embodiment of the invention, without restricting it to this one, will now be explained in more detail with reference to the drawing. Shown in the drawing are:

Fig. 1: a circuit diagram of a control circuit according to the invention for relay-operated gas valves; and

Fig. 2: a diagram for clarifying the functioning of the control circuit according to the invention for relay-operated gas valves.

This present invention will now be described in greater detail with reference to Fig. 1 and 2.

Fig. 1 shows a control circuit 10 according to the invention for relay-operated gas valves, the control circuit according to the invention including a relay 11 and a failsafe circuit 12 for the relay 11. The failsafe circuit 12 has an input 13, at which a control device, not shown, in particular a control device developed as a microprocessor, can be connected. The control device supplies an input signal at the input 13 of the failsafe circuit 12 or at the input 13 of the control circuit 10, in the sense of this present invention the failsafe circuit 12 then only supplying at the relay 11 with a voltage necessary for opening the gas valve when a signal having at least two different frequency signals succeeding each other in time is supplied at the input 13 by the control device.

In the sense of this present invention, the failsafe circuit 12 of the control circuit 10 according to the

invention includes a charging circuit 14 and a drive circuit 15. The charging circuit 14 includes the components surrounded by a dashed box in Fig. 1; the components of the drive circuit 15 are surrounded in Fig. 1 by a dotted and dashed box.

As can be seen from Fig. 1, the charging circuit 14 includes a capacitor 16, with two diodes 17 and 18 connected in parallel to the capacitor 16. Fig. 1 shows that the cathode of the diode 18 is in contact with the anode of the diode 17. The capacitor 16 is connected in parallel to the two diodes 17 and 18 in such a manner that the capacitor is in contact with the cathode of the diode 17 on one side and with the anode of the diode 18 on the other side. Connected between the two diodes 17 and 18 is a resistor 19, which with interposed capacitors 20, 21, 22 and 23 is connected to the input 13 of the failsafe circuit 12. Instead of the four capacitors 20 to 23 shown in Fig. 1, it is also possible to use only one capacitor of appropriately sized capacity.

The drive circuit 15 includes, among other things, two transistors 24 and 25. A first transistor 24 is connected with its base to the capacitor 16 of the charging circuit 14, with an interposed resistor 26. The collector of the transistor 24, which according to Fig. 1 is developed as an NPN transistor, is connected with an interposed further resistor 27 to a supply voltage V of the control circuit 10 according to the invention. With its emitter, on the other hand, the transistor 24 is connected to a ground potential or earth potential. A second transistor 25 is switched with the first transistor 24 in such a manner that the collector of the second transistor 25, which like the first transistor 24 is developed as an NPN transistor, is connected to the base of the first transistor 24.

The emitter of the second transistor 25 is connected, like the emitter of the first transistor 24, to the ground potential or earth potential. The base of the second transistor 25 is connected with an interposed resistor 28 to the input 13 of the control circuit 10.

According to Fig. 1, the drive circuit 15 includes, in addition to the two transistors 24, 25 and the resistors 26, 27 and 28, further two Darlington transistor circuits 29 and 30, each of which has two transistors switched in the so-called Darlington circuit. According to Fig. 1, the two transistors of the Darlington transistor circuit 29 are developed as NPN transistors, the two transistors of the Darlington transistor circuit 30 on the other hand being developed as PNP transistors. The two Darlington transistor circuits 29 and 30 are connected together at their base and coupled to the collector of transistor 24. It can further be seen from Fig. 1 that the emitters of the Darlington transistor circuits 29 and 30 are also connected to each other, a series connection of a resistor 32 and a capacitor 33 being in contact at this connection point 31 of the emitters. The collector of the Darlington transistor circuit 29 is on the potential of the supply voltage V; the collector of the Darlington transistor circuit 30, on the other hand, is on the ground potential together with the emitters of the transistors 24 and 25. A diode 34 is connected in parallel to the relay 11, the diode 34 being switched with its anode to the collector of the Darlington transistor circuit 29 and with its cathode with the capacitor 33.

As already mentioned, the control circuit 10 according to the invention or the failsafe circuit 12 of the same only supplies the relay 11 with a voltage necessary for opening the gas valve when an input signal including at

least two different frequency signals succeeding each other in time is supplied at the input 13 of the failsafe circuit 12by the control device. In this case a defined operating state of the control device for opening the gas valve is present.

In the preferred embodiment of this present invention, the gas valve is only opened by the relay 11 if the signal supplied by the control device at the input 13 includes two frequency signals, namely a first frequency signal with a frequency of around 1000 kHz and a second frequency signal with a frequency of around 5 kHz, which are applied or present succeeding one another in time in such a manner in the signal supplied by the control device, that in each case a time span of around 40 ms with the first frequency signal of around 1000 kHz is followed by a time span of around 80 ms with the second frequency signal of around 5 kHz. Fig. 2 visualizes such an input signal, as supplied by the control device, as a solid line, where in each case a time span t_1 with the frequency signal of around 1000 kHz is followed by a time span t_2 with the frequency signal of around 5 kHz.

The control circuit 10 according to the invention now works in such a manner that upon the application or presence of the first frequency signal of around 1000 kHz at the input 13 of the failsafe circuit 12, the charging circuit 14 charges the capacitor 16 of same. During the application of the second frequency signal of around 5 kHz at the input 13, on the other hand, the capacitor 16 of the charging circuit 14 cannot be charged, but instead during the time span in which the second frequency signal of around 5 kHz is applied, a discharge of the capacitor 16 of the charging circuit 14 takes place over the resistor 26 and the base of the transistor 24. It should further be noted that during

the time span in which the second frequency signal of around 5 kHz is applied at the input 13, there is a rectangular 5 kHz signal at the connection point 31. Thereby, on the one hand, the capacitor 33 of the drive circuit 15 is charged over the diode 34, and on the other hand there is a discharge over the relay 11. In the discharge a direct current flows through the relay 11. In the time span in which the first frequency signal of around 1000 kHz is applied, the capacitor 33 of the drive circuit 15 can discharge over the relay 11. The transistor 24 of the drive circuit 15 is only conducting if from the discharge of the capacitor 16 a current flows at its base.

During the time span in which the first frequency signal with the relatively high frequency of around 1000 kHz is applied at the input 13, the capacitor 16 of the charging circuit 14 is indeed being charged, but the drive circuit 15 is not conducting because of the so-called feedback capacity of the transistor 25 and because of the relatively large resistor 28. The drive circuit 15 is only conducting when, during the time span in which the second frequency signal with the relatively low frequency of 5 kHz is applied at the input 13, the capacitor 16 of the charging circuit 14 discharges over the resistor 26 and the base of the first transistor 24. The charging and discharging of the capacitor 16 of the charging circuit 14 during the time spans t_1 and t_2 with the different frequency signals is represented in Fig. 2 by the broken line 35. As can be seen from Fig. 2, the capacitor 16 is charged during the time span t_1 in which the first frequency signal of around 1000 kHz is applied, while a discharge of the capacitor 16 occurs during the time span t_2 in which the second frequency signal of around 5 kHZ is applied.

By supplying a signal at the input 13 of the control circuit 10 according to the invention, in which signal the two frequency signals of around 1000 kHz and around 5 kHz succeed each other in a defined time, a voltage necessary to open the gas valve can be permanently supplied at the relay 11. In the time span in which the first frequency signal of around 1000 kHz is applied at the input 13, the capacitor 33 of the drive circuit 15 discharges, as a result of which the voltage necessary to open the gas valve is maintained at the relay. During the time span for which the second frequency signal of around 5 kHz is applied at the input 13 and the capacitor 16 of the charging circuit 14 discharges, the drive circuit 15 is conducting and there is a rectangular 5 kHz signal at the connection point 31. As a result of this, on the one hand the capacitor 33 is charged over the diode 34, and on the other hand there is a discharge over the relay 11. In the discharge a direct current flows through the relay 11. During the presence of the first frequency signal of around 1000 kHz, the transistor 25 is continuously conducting, as a result of which the voltage at the emitters of the Darlington transistor circuits 29 and 30 becomes high. Since during the time span in which the first frequency signal of around 1000 kHz is applied at the input 13, the voltage necessary to open the gas valve is maintained at the relay 11 by the discharge of the capacitor 33, this time must be shorter than the discharge time of the capacitor 33.

The actual design of the control circuit described above is up to the person skilled in the art who is addressed here. In the especially preferred embodiment, the capacitance of the capacitor 16 of the charging circuit is 10 μF, the capacitance of each of the capacitors 20, 21, 22, 23 is 100 pF. The capacitance of the capacitor 33 of the drive circuit is preferably

47 μF. The resistor 19 is preferably sized at 1 kΩ, the resistor 28 at 1 MΩ. The resistor 26 is preferably 47 kΩ, the resistor 27 100 kΩ. The resistor 32 is preferably 51Ω. The supply voltage V is 24 V. With this sizing for the circuit, the discharge time of the capacitor 16 over the resistor 26 is about 116 ms, its charge time is about 40 ms.

Reference number list

10	Control circuit
11	Relay
12	Failsafe circuit
13	Input
14	Charging circuit
15	Drive circuit
16	Capacitor
17	Diode
18	Diode
19	Resistor
20	Capacitor
21	Capacitor
22	Capacitor
23	Capacitor
24	Transistor
25	Transistor
26	Resistor
27	Resistor
28	Resistor
29	Darlington transistor circuit
30	Darlington transistor circuit
31	Connection point
32	Resistor
33	Capacitor
34	Diode